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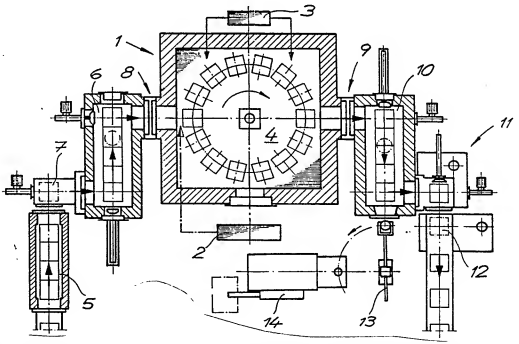
(54) Title: A PROCESS FOR HEAT TREATMENT OF WORKPIECES AND A HEAT TREATMENT INSTALLATION SUITABLE FOR SUCH A PROCESS

(57) Abstract

Process for heat treatment of workpieces corresponding to different heat treatment profiles, said profiles being the same within each charge of workpieces, in an automatic heat treatment installation, whereby the workpieces having the same heat treatment profile are collected in workpiece charges and the workpiece charges are subjected to different heat treatment conditions in a heat treatment furnace. The heat treatment conditions are determined by the furnace atmosphere, the treatment temperature and the treating time. The workpiece charges are treated in a rotating hearth furnace (1) in which the furnace atmosphere and the treatment temperature are kept constant. The differing heat treatment conditions are achieved by varying the travel paths and thus the treatment time of the workpiece charges in the rotating hearth furnace. A device for carrying out the process is provided with appropriate equipment (2) for setting the heat treatment conditions acting on the rotating hearth.



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A process for heat treatment of workpieces and a heat treatment installation suitable for such a process

The present invention relates to a process for heat treatment of workpieces of steel or of other alloys, corresponding to different heat treatment profiles, said profile being the same within each charge of workpieces, in an automatic heat treatment installation, whereby the workpieces having the same heat treatment profile are collected in workpiece charges and the workpiece charges are subjected to different heat treatment conditions in a heat treatment furnace, said heat treatment conditions being determined by the furnace atmosphere, the treatment temperature and the treating time. In automatic heat treatment furnaces, the passage times for the charges are usually fixed, but can some times be adjusted for certain operating conditions. The heat treatment profile determines, as is known, the depth of treatment, for example the case depth which the specifications for the workpiece require. The term heat treatment encompasses both purely thermal treatment and chemical treatment with replacement of substances, in particular carbonization treatment.

Within the scope of the known processes of this type used in practice, the workpiece charges are treated in a continuous discharge furnace. The varying heat treatment conditions are set by changing the furnace atmosphere and/or the treatment temperature, since the passage time is preset by the fixed speed of the charges passing in sequence. The conditions are similar when a chamber furnace is used as a heat treatment furnace. Within the scope of the known processes, using either a continuous discharge furnace or a chamber furnace, the workpieces are held for a predetermined period in order to achieve a given heat treatment profile. If one wishes to achieve different

heat treatment profiles with a single furnace, the furnace atmosphere must be appropriately regulated or the temperature must be changed. These regulating procedures require significant down-time periods. This is especially true for carbonization treatment. The heat treatment installations used in the known processes have for setting the heat treatment condition regulating and control equipment for influencing the furnace atmosphere or the treatment temperature.

The purpose of the invention is to conduct the process of the type described, so that the setting of different heat treatment conditions for individual charges does not require changing of the furnace atmosphere and/or the treatment temperature. The invention has the further purpose of providing a particularly simple and reliable heat treatment installation for the process according to the invention.

To achieve these purposes, the invention provides a process whereby the workpiece charges are treated in a rotating hearth furnace. The differing travel paths can be achieved in a particularly simple manner if the workpiece charges are introduced into the rotating hearth furnace through an entry lock and removed from the rotating hearth furnace via at least one exit lock. It lies within the scope of the invention, however, to introduce and remove the charges via a single lock if the treatment cycles so permit. The different distances travelled can be achieved with a rotating hearth rotating in one direction or with a reversible rotating hearth. It is immediately possible to carry out the process according to the invention in such a manner as to be applicable to widely varying workpiece charges and so as to be able to set the appropriate distance travelled automatically from charge to charge. Furthermore, according to the invention, the distance

travelled can be controlled with the aid of a computer control means in response to machine readable charge data on the workpiece charges.

In other words, the invention teaches the procedure of collecting the pieces requiring a particular heat treatment profile and thus a particular case depth, into a single charge and transporting them in this charge through the rotating hearth furnace. The passage through the rotating hearth furnace is regulated so that the staying time to achieve a particular heat treatment profile and thus a particular treatment depth is not exceeded. In other words, when there are charges in the rotating hearth furnace which require different heat treatment profiles, a workpiece charge will be removed from the furnace at the moment when the heat treatment profile has just been reached. The rotating hearth furnace can then be loaded, for example, via the entry lock. Loading and unloading of the furnace can be controlled so that the turning of the turn-table is kept to a minimum. This is easily achieved by means of a computer. The entire flow of workpieces through the heat treatment installation is controlled by an optimizing calculator for the rotating hearth furnace, depending on the number or workpieces to be treated and the heat treatment profile/treatment depth. If, for example, a controlling computer determines, when looking at the coming flow of materials over a long period of time, that the heat treatment temperature and composition of the furnace atmosphere should be changed to optimize energy consumption, then this should result in an operative resetting. Otherwise the process proceeds from setting to setting according to the invention.

The advantages achieved with regard to the process lie in the fact that the composition of the furnace atmosphere and/or the treatment temperature

need not be changed in the process according to the invention, thus eliminating the disruptive down-time described above. This ineffective time is reduced almost to the turning time of the turn-table in the rotating hearth furnace. An installation for carrying out the process according to the invention which works with a heat treatment furnace and equipment for setting the heat treatment conditions is characterized in that the heat treatment furnace is a rotating hearth furnace, the furnace atmosphere and the treatment temperature which can be differently adjusted during operation and can be kept constant in the thus adjusted state with the aid of control and/or regulating equipment, and that the equipment operates to set the heat treatment conditions of the rotating hearth and directs the workpiece charges having different heat treatment profiles to different travel paths.

The invention will be described below in more detail with reference to a drawing serving only as an example. The single drawing shows an installation for carrying out the process described. The example relates to a carbonization furnace, but applies correspondingly to other heat treatment installations.

The primary components of the carbonization installation include a carbonization furnace 1 and equipment 2 for setting the carbonization conditions. The carbonization furnace 1 is a rotating hearth carbonization furnace. The device is designed so that the equipment 3 in the figure adjusts the carbonization atmosphere and the carbonization temperature independently and holds the thus adjusted states constant with the aid of control and/or regulator equipment. The equipment 2 for setting the carbonization conditions is indicated at the bottom of the figure and works on the turn-table. The arrangement is such that this equipment 2 directs

workpiece charges with different carbonization profiles to different travel paths. This equipment detects charge data readable on the workpiece charges as indicated by the dash-dot line. The turn-table 4 can rotate forwards and backwards. The figure indicates that a preheating furnace 5 and a heat-up chamber 6 can be added to the rotating hearth furnace 1 and that these two additions can be joined to each other via a lock 7 and that the rotating hearth furnace 1 and the heat-up chamber 6 are connected via an entry lock 8. On the other side the example shows an exit lock 9 which is connected to a diffusion chamber 10 and which can be connected via a further lock 11 to an oil bath 12 for example.

It is to be understood that additional equipment can be provided. For example, a manipulator 13 and a hardening press 14 can be connected to the furnace 4.

CLAIMS

1. Process for heat treating of workpieces corresponding to different heat treatment profiles, said profiles being the same within each charge of workpieces, in an automatic heat treatment installation, whereby the workpieces having the same heat treatment profile are collected in workpiece charges and the workpiece charges are subjected to different heat treatment conditions in a heat treatment furnace, said heat treatment conditions being determined by the furnace atmosphere, the treatment temperature and the treatment time, characterized in that the workpiece charges are treated in a rotating hearth furnace in which the furnace atmosphere and the treatment temperature are kept constant, and that the differing heat treatment conditions are achieved by varying the travel path and thus the treatment time of the workpiece charges in the rotating hearth furnace.

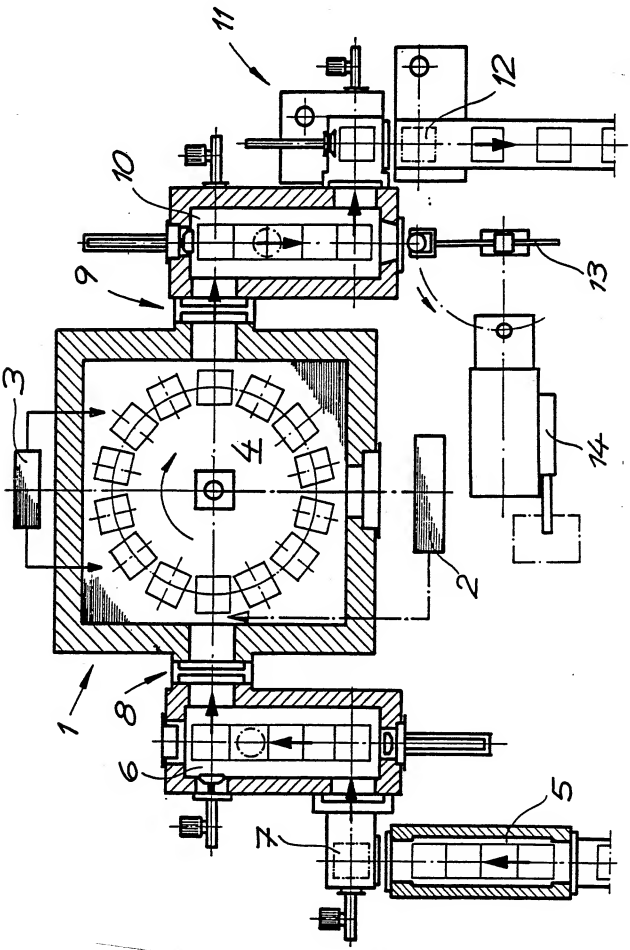
2. Process according to Claim 1, characterized in that the workpiece charges are introduced into the rotating hearth furnace through an entry lock and are removed from the rotating hearth furnace via at least one exit lock.

3. Process according to any one of Claims 1 or 2, characterized in that the travel paths are achieved by rotating the rotating hearth in one direction or by reversing the direction.

4. Process according to any one of Claims 1-3, characterized in that the travel path is controlled with the aid of a computer control means in response to machine readable charge data on the workpiece charges.

5. Heat treatment installation for carrying out the process according to any one of Claims 1-4, with a heat treatment furnace and equipment for setting the heat treatment conditions, characterized in that the

heat treatment furnace (1) is a rotating hearth furnace, the furnace atmosphere and the treatment temperature of which can be differently adjusted during the operation and can be kept constant in the thus adjusted state with the aid of control and/or regulating equipment, and that the equipment (2) operates to set the heat treatment conditions of the rotating hearth and direct the workpiece charges having different heat treatment profiles to different travel paths.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INTERNATIONAL SEARCH REPORT

Internationel Application No PCT/SE85/00375

I. CLASSIFICATION OF SUBJECT MATTER (if saveral classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC 4

C 21 D 9/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]	
Classification System	Classification Symbols
IPC 4	C 21 D 9/00, /08, /34, /36, /38, /40, /54, 1/74
Nat Cl	18c:8/90, 9/03
US Cl	266:156, 250, 252

Documentation Searched other then Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	DE, C, 684 954 (UHLENDORFF) 8 December 1939	1,2,5
X	DE, C, 971 225 (A.E.G.) 31 December 1958	1,2,5
X	DE, B, 1 201 380 (LEE WILSON) 23 September 1965	1,2,5
X	EP, A1, 98 344 (DAIDOTOKUSHUKO KABUSHIKI-KAISKA) 18 January 1984 & JP, 58217625 US, 4496312	1,2,5
X	FR, A, 1 072 554 (CHAUFFERIE ET FUMISTERIE INDUSTRIELLES) 14 September 1954	1,2,5
X	FR, A, 1 218 675 (SALEM-BROSIUS) 12 May 1960	1,2,5
X	GB, A, 920 150 (SALEM-BROSIUS) 27 October 1961	1,2,5

* Special categories of cited documents: [10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
1985-12-16	1985 -12- 20
International Searching Authority	Signature of Authorized Officer
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